

CLAIMS:

1. A pharmaceutical composition comprising core-shell particles wherein said core-shell particles comprise a core component and a shell component, said particles binding in an animal subject a greater amount of a target solute in the presence of said shell component compared to the amount of target solute bound in the absence of said shell component and retaining a significant amount of said bound target solute during a period of therapeutic and/or prophylactic use.
2. The pharmaceutical composition of claim 1 wherein said core component binds a greater amount of said target solute in the presence of said shell component compared to the amount of target solute bound in the absence of said shell component.
3. The pharmaceutical composition of claim 1 wherein said target solute is not a bile acid or a sodium ion.
4. The pharmaceutical composition of claim 1 wherein said shell component preferentially excludes a bile acid or a sodium ion.
5. A pharmaceutical composition comprising core-shell particles wherein said core-shell particles comprise a core component and a shell component, said particles binding in an animal subject a greater amount of a target solute in the presence of said shell component compared to the amount of target solute bound in the absence of said shell component, wherein said target solute is not a bile acid or a sodium ion.
6. A pharmaceutical composition comprising core-shell particles wherein said core-shell particles comprise a core component and a shell component, said particles binding in an animal subject a greater amount of a target solute in the presence of said shell component compared to the amount of target solute bound in the absence of said shell component; wherein if said target solute is a bile acid, the core component binds an additional target solute, said additional target solute not being a bile acid.
7. The pharmaceutical composition of claim 1, 5, or 6 wherein said target solute is a hydrophilic ion.
8. The pharmaceutical composition of claim 1, 5, or 6 wherein said target solute is a biological toxin.

9. The pharmaceutical composition of claim 8 wherein said biological toxin is urea or creatinine.
10. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component is capable of modulating a movement of said target solute and/or of a competing solute into and/or out of said core-shell particle.
11. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component retains a significant amount of said bound target solute during a period of therapeutic and/or prophylactic use.
12. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component is characterized by a higher permeability for said target solute compared to a permeability for one or more competing solutes.
13. The pharmaceutical composition of claim 12 wherein said permeability properties of said shell component are modulated by an environment of the gastrointestinal tract.
14. The pharmaceutical composition of claim 12 wherein said permeability of said shell component to said target solute is modified in different environments.
15. The pharmaceutical composition of claim 14 wherein said shell component has increased permeability to said target solute in a first environment and a decreased permeability to said target solute in a second environment.
16. The pharmaceutical composition of claim 12 wherein said permeability of said shell component to said target solute is independent of said permeability of said shell component to said competing solute.
17. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component is physically or chemically attached to said shell component.
18. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component comprises of a metal or a non-metal containing composition.
19. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component is hydrophobic.
20. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component exhibits a greater interaction with said competing solute compared to said target solute.
21. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component repels said competing solute.

22. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component is about 1nm to about 50 μm thick.

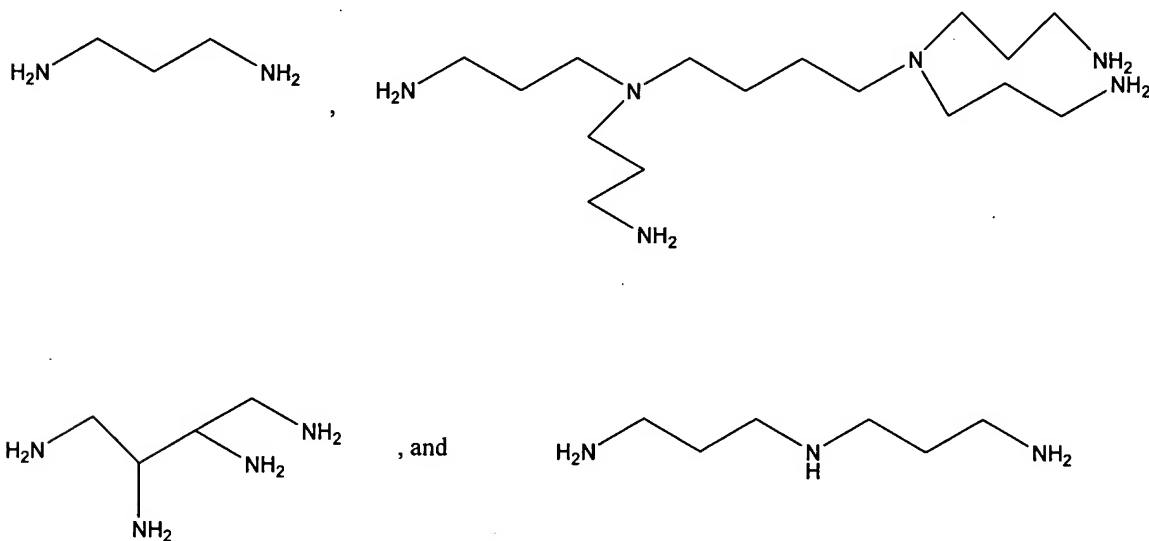
23. The pharmaceutical composition of claim 1, 5, or 6 wherein said core-shell particle is about 200 nm to about 2 mm in size.

24. The pharmaceutical composition of claim 23 wherein said core-shell particle is about 500 μm in size.

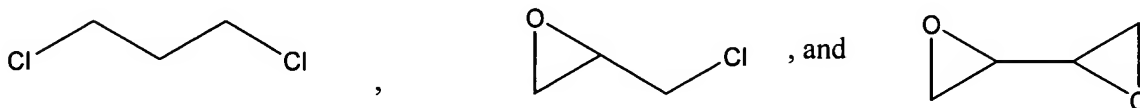
25. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component is selected from the group consisting of optionally crosslinked polyallylamine polymer, polyvicinalamine polymer, polyvinylamine and polyethyleneimine polymer.

26. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component comprises a 1,3-diamino propane/1,3-dichloropropane crosslinked polymer or a 1,3-dichloropropane/epichlorohydrin crosslinked polymer.

27. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component comprises an optionally crosslinked polymer, said polymer comprising a repeat unit selected from the group consisting of



28. The pharmaceutical composition of claim 27 wherein said polymer is crosslinked with a crosslinker selected from the group consisting of



29. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component is synthesized using a material selected from the group consisting of 3-(1H, 1H, 7H-dodecafluoroheptyloxy)-1,2-epoxypropane; glycidyl 4-nonylphenyl ether; glycidyl hexadecyl ether; 2-[(4-nitrophenoxy)methyl]oxirane; poly(bisphenol A-co-epichlorohydrin), glycidyl end-capped; and poly(o-cresyl glycidyl ether)-co-formaldehyde).

30. The pharmaceutical composition of claim 29 wherein said core component comprises an amine containing polymer and said material used to synthesize said shell chemically reacts with said amine in said core component.

31. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component is deposited with a coating process.

32. The pharmaceutical composition of claim 1, 5, or 6 wherein said shell component comprises an enteric coating.

33. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component comprises a 1,3-diamino propane/1,3-dichloropropane crosslinked polymer and said shell component is synthesized using a material selected from the group consisting of 3-(1H, 1H, 7H-dodecafluoroheptyloxy)-1,2-epoxypropane; glycidyl 4-nonylphenyl ether; glycidyl hexadecyl ether; 2-[(4-nitrophenoxy)methyl]oxirane; poly(bisphenol A-co-epichlorohydrin), glycidyl end-capped; and poly(o-cresyl glycidyl ether)-co-formaldehyde).

34. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component comprises an epichlorohydrine crosslinked polyallylamine polymer and said shell component comprises a block copolymer, said block copolymer comprising a hydrophobic block and an amine reactive hydrophilic block.

35. The pharmaceutical composition of claim 34 wherein said hydrophobic block is at least one of poly(n-butyl acrylate-co-t-butyl acrylate) or poly(N,N-di-n-butyl acrylamide-co-t-butyl acrylate) and said amine reactive block is poly-(N,N-dimethylacrylamide-co-glycidyl methacrylate).
36. The pharmaceutical composition of claim 1, 5, or 6 wherein said core component is present in an amount less than an amount administered to an animal subject in the absence of said shell component.
37. A method of treating an animal subject comprising administering to an animal subject in need thereof an effective amount of said pharmaceutical composition of claim 1, 5, or 6.
38. The method of claim 37 wherein said pharmaceutical composition removes ions from a gastro-intestinal tract.
39. The method of claim 38 wherein said pharmaceutical composition removes phosphate from the gastrointestinal tract.
40. The method of claim 39 wherein said animal subject is suffering from a disease selected from the group consisting of hyperphosphatemia, hypocalcemia, hyperparathyroidism, depressed renal synthesis of calcitriol, tetany due to hypocalcemia, renal insufficiency, ecotopic calcification in soft tissues, and ESRD.
41. The method of claim 37 wherein said pharmaceutical composition removes sodium ions from a gastrointestinal tract.
42. The method of claim 41 wherein said animal subject is suffering from hypertension, chronic heart failure, end stage renal disease, liver cirrhosis, chronic renal insufficiency, fluid overload, or sodium overload.
43. The method of claim 37 wherein said pharmaceutical composition removes potassium ions from a gastrointestinal tract.
44. The method of claim 43 wherein said animal subject is suffering from hyperkalemia, metabolic acidosis, renal insufficiency, anabolic metabolism.